	Type	L #	Hits	Search Text	DBs	Time Stamp	Comments	Error Definition	Errors
1	BRS	L7	42580	((charge with storage with device41) or batter$3 or capacitor$1 or supercapasitor$1 or (fuel adj cell$1)) with (design$3 or emulat$3 or simulat$3)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:46			0
2	BRS	L8	2	(((charge with storage with device41) or batter$3 or capacitor$1 or supercapasitor$1 or (fuel adj cell$1)) with (design$3 or emulat$3 or simulat$3)) and ((customer adj driven) with (design or designing))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 17:41			0
3	BRS	L9	3	(customer adj driven) with (design or designing)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 17:48			0
4	BRS	L10	37	((charge with storage with device41) or batter$3 or capacitor$1 or supercapasitor$1 or (fuel adj cell$1)) with (design$3 or emulat$3 or simulat$3) with customer	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 17:41			0
5	BRS	L11	17	(((charge with storage with device41) or batter$3 or capacitor$1 or supercapasitor$1 or (fuel adj cell$1)) with (design$3 or emulat$3 or simulat$3) with customer) and	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 17:41			0
6	BRS	L12	3	((((charge with storage with device41) or batter$3 or capacitor$1 or supercapasitor$1 or (fuel adj cell$1)) with (design$3 or emulat$3 or simulat$3) with customer) and interface) and test	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 17:41			0
7	BRS	L13	5	((((charge with storage with device41) or batter$3 or capacitor$1 or supercapasitor$1 or (fuel adj cell$1)) with (design$3 or emulat$3 or simulat$3) with customer) and interface) and test$3	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 17:41			0
8	BRS	L14	12	((((charge with storage with device41) or batter$3 or capacitor$1 or supercapasitor$1 or (fuel adj cell$1)) with (design$3 or emulat$3 or simulat$3) with customer) and interface) not (((((charge with storage with device41) or batter$3 or capacitor$1 or supercapasitor$1 or (fuel adj cell$1)) with (design$3 or emulat$3 or simulat$3) with customer) and interface) and test$3)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 17:42			0
9	BRS	L15	20	(((charge with storage with device41) or batter$3 or capacitor$1 or supercapasitor$1 or (fuel adj cell$1)) with (design$3 or emulat$3 or simulat$3) with customer) not ((((charge with storage with device41) or batter$3 or capacitor$1 or supercapasitor$1 or (fuel adj cell$1)) with (design$3 or emulat$3 or simulat$3) with customer) and	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 17:42			0
10	BRS	L16	4	("6016047" "6160382").pn.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 17:44			0
11	BRS	L17	5	6160382.URPN.	USPAT	2003/10/27 17:43			0
12	BRS	L18	9	6016047.URPN.	USPAT	2003/10/27 17:43			0
13	BRS	L19	4091	705/1,7,27,500.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 17:45			0
14	BRS	L20	2164	324/426,427,428,429,430,431,432,433,434,435,436.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 17:46			0
15	BRS	L21	231	702/65.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:42			0
16	BRS	L22	2023	703/2,4,14,15,18,21.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 17:47			0

	Type	L #	Hits	Search Text	DBs	Time Stamp	Comments	Error Definition	Errors
17	BRS	L23	0	20 and 22	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 17:47			0
18	BRS	L25	0	(customer adj driven) and 24	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 17:48			0
19	BRS	L26	0	(customer with interface) and 24	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 17:48			0
20	BRS	L27	0	(customer with input) and 24	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 17:49			0
21	BRS	L28	0	(customer with characteristic$1) and 24	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 17:49			0
22	BRS	L24	119	7 and 22	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:38			0
23	BRS	L29	5	sell$3 with batter$3 with (internet or network)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:40			0
24	BRS	L30	3294524	MATSUSHITA DENKI SANGYO KK	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:40			0
25	BRS	L31	100354	"MATSUSHITA DENKI SANGYO KK"	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:40			0
26	BRS	L32	100749	"MATSUSHITA DENKI "	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:40			0
27	BRS	L33	100749	MATSUSHITA adj DENKI	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:41			0
28	BRS	L34	4574	33 and battery	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:42			0
29	BRS	L35	0	34 and sell$3 and design$3	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:41			0
30	BRS	L36	1	34 and sell$3	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:41			0
31	BRS	L38	0	37 and 22	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:43			0
32	BRS	L39	893	702/65,117,120.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:43			0
33	BRS	L40	0	37 and 39	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:43			0
34	BRS	L41	0	37 and 705/$7.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:43			0
35	BRS	L42	0	37 and 24	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:43			0

	Type	L #	Hits	Search Text	DBs	Time Stamp	Comments	Error Definition	Errors
36	BRS	L37	36	34 and model$4	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:44			0
37	BRS	L43	1	37 and simulat$3	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:44			0
38	BRS	L44	3	34 and simulat$3	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:45			0
39	BRS	L45	290	33 and simulat$3	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:45			0
40	BRS	L46	3	45 and battery	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:45			0
41	BRS	L47	4095	((charge with storage with device41) or batter$3 or capacitor$1 or supercapasitor$1 or (fuel adj cell$1)) with simulat$3	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:47			0
42	BRS	L48	3	19 and 47	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:51			0
43	BRS	L49	63	20 and 47	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:53			0
44	BRS	L50	1	49 and 39	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:53			0
45	BRS	L51	0	49 and 22	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:53			0
46	BRS	L52	63	49 not 24	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/10/27 18:53			0

Electronic Design
Oct 1, 1998

Methods To Qualify ACPI Smart-Battery Implementations.

Author/s: Robert A.^Mummah Dunstan Phil

Robert A. Dunstan and Phil Mummah, Intel Corp., Mobile Handheld Products Group. From the 1998 Portable By Design Conference.

The Advanced Configuration Power Interface (ACPI) defines the software and hardware interface between the operating system (OS) and the SMBus system. The interface goes through an embedded controller. This definition allows the OS to directly communicate with the Smart Battery system, which provides the OS with consistent and accurate battery data while optimizing battery system performance. Maximum run time requires the OS to get accurate battery data and for the battery system to deliver optimal charging and discharging performance. This is accomplished by allowing the battery to determine its own charging algorithm. Thus an ACPJ-compliant Smart Battery system is both accurate and chemistry independent.

In order to test Smart Battery data, we are proposing a software controllable tool, the Battery Test Workbench (BTW). This tool must have many test and measurement capabilities:

* ability to measure voltage and current at the battery terminals,

* a programmatically controllable load,

* a programmatically controllable charger,

* an ohmmeter to measure thermistor pin values, and

* an SMBus activity monitor.

The BTW consists of the battery to be tested, the test fixture, and a computer to control the test fixture. Its use will be described at a general level with its possible uses to test Smart Batteries and other Smart Battery system components. While the particular hardware and automated control is only a proposal, the tests and test methodologies can be done with off-the-shelf test equipment.

The capability to perform automated battery tests, although time consuming, is highly desirable. Smart Batteries are electro-chemical systems coupled with electronics. These electrochemical systems change with use, and the electronics try to compensate for these changes. With age, battery errors can grow, so it is important to cycle the battery a number of times to accurately gauge the capacity and reported run times. Measuring battery data accuracy is the key goal of the BTW. Smart Batteries, unlike other batteries, must report data within tolerances of 1%.

The type and characteristics of the load placed on the battery during testing are very important. Battery vendors normally use a constant-current load based on a 5-hr. rate to report capacity. However, a notebook computer presents an entirely different type of load, a rather dynamic constant-power load.

The most important characteristics that must be tested are the capacity, the alarms, and the remaining-time data. Additionally, there is other information that can and should be tested at the same time. For example, the reported error can be tested along with the amount of remaining energy actually left when the battery reports that it is fully discharged. There are certainly other data values that may be tested as well.

The test methodology is to use the charge voltage and current commands to set the output of the programmable power supply. The voltage and current reported by the battery should be compared to the values read by the data acquisition system. When the battery tries to end charging by sending a zero charging current or voltage, or a terminate charge alarm, the programmable power supply should be turned off. The battery at this time should be fully charged. Several battery data values should be read and recorded, including battery capacity, last full charge capacity, max error, and the status.

There are three types of discharge tests that need to be run. First is the C/5 test, where the battery's design capacity in milliamp-hours is divided by five and used as the load placed on the battery. The battery is discharged until it sends a terminate discharge alarm or a predetermined cutoff voltage level is reached. The measured capacity is then compared with the reported capacity. If the battery terminate-discharge alarm causes the discharge to end (normal case), the battery should then be discharged until the cutoff voltage is reached. The energy extracted from the battery at this step is useable energy that is unavailable to the user. The battery is recharged and the test repeated.

The second test is much like the first except the battery is placed in the power mode and a P/5 constant-power load is applied. This test is important to confirm that the battery reasonably reports its capacity in terms of energy.

The third test is more extensive, testing the battery capacity using the simulated notebook load. In this case the charge cycle remains the same, but the remaining time is tracked throughout the

discharge cycle.

Unlike the previous tests, the use of a dynamically changing load means that the remaining time will not monotonically de crease and the remaining capacity will not track with the energy delivered. The most important information from the 05 point of view is the alarm information. The user wants accurate remaining time and both want to extract all the available energy. In this case, the remaining time is recorded and plotted At the end of each discharge run, the actual run time can be overlaid as a straight line on top of the remaining times returned by the battery. The net area between the two curves should approach zero.

Additional testing should be done to simulate a typical user's charge/discharge pattern. For this test, the battery should be fully discharged and then fully charged. This should allow the battery electronics to accurately determine the end points and establish a known capacity. The battery should accurately report capacity and remaining time, taking max error into account.

The SMBus Implementers Forum is responsible for publishing and maintaining the SMBus Specification as well as the Smart Battery Data Specification, the Smart Charger Specification, and the Smart Battery Selector specification. Join and participate in the SBS Implementers Forum to help maintain and improve these specifications. Build products that comply with the specifications and test them for compliance.

In particular, test the system ACPI compliance. Focus on the Smart Battery's data to ensure that it accurately reports information and is able to supply all its available energy. This ultimately will ensure consumer satisfaction and help the OS take full advantage of the battery.
